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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/878,820	06/11/2001	Shiqun Gu	01-096	3179

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LSI LOGIC CORPORATION
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EXAMINER
DEO, DUY VU NGUYEN

ART UNIT	PAPER NUMBER
1765	4

DATE MAILED: 12/26/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/878,820	GU ET AL.	
	Examiner	Art Unit	
	DuyVu n Deo	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 November 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 7-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5, 7-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 3-5, 7, 11, 12, 15, 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu et al. (US 6,323,121) and Wang et al. (US 6,365,495).

Liu describe a method for forming a conductive via comprising: forming a via cavity in a first dielectric to expose a first conductive layer; etching the via with a hydrogen-containing plasma including H2; forming a liner, such as TiN as a barrier, in the via; forming a second conductive layer adjacent the liner layer and substantially filling the via (col. 6, line 50-col. 7, line 30).

Unlike claimed invention, Liu doesn't describe an isotropic plasma treatment of the liner layer before formation of the second conductive layer. Wang teaches a method of forming the liner, TiN, where he teaches of a plasma treatment of the TiN with H2 and N2 gases (col. 10, line 10-68). This would read on claimed isotropic plasma treatment of the TiN. It would have been obvious for one skilled in the art to modify Liu's method in light of Wang's plasma treatment to treat the whole surface of the TiN, including the sidewalls, because it would decreases resistivity, increases purity, densifies, and improves stability of the TiN as a barrier.

Referring to claim 3, the hydrogen-containing plasma would also remove any carbon and oxygen from a residue on the first conductive layer in the via. Referring to claim 5, using CVD to deposit any material including TiN is well known to one skilled in the art at the time of the invention as shown by Wang (col. 5, line 7).

3. Claims 2, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu and Wang as applied to claims 1 and 11 above, and further in view of Bersin et al. (US 5,882,489).

Unlike claims 2 and 16, Liu doesn't describe a step of Ar sputtering before depositing the liner to remove residue on the conductive layer. Bersin teaches a method of cleaning a via and conductive layer in the via using Ar sputtering (col. 3, line 33-35; col. 4, line 28-31; col. 5, line 5, line 8-10). It would have been obvious for one skilled in the art to modify Liu's in light of Bersin's cleaning method because the Ar sputtering cleaning step would remove insoluble and nonvolatile residues off the conductive layer in the via.

4. Claims 8, 9, 13, 14, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu and Wang as applied to claims 1 and 11 above, and further in view of Lin et al. (US 6,133,143).

Referring to claims 8 and 13 using a Ti/TiN layers in the process of forming metal interconnect is well known to one skilled in the art as shown here by Liu to form barrier/diffusion layer (col. 4, line 35-48). Lin also describe other metal layer such as W can be used to fill the via hole (col. 4, line 51). Therefore, at the time of the invention, using other

metal including W to fill the via hole would have been obvious to one skilled in the art to form a conductive plug with an expect of reasonable success.

5. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu, Lin, Wang, and Bersin.

Liu describe a method for forming a conductive via comprising: forming a via cavity in a first dielectric to expose a first conductive layer; etching the via with a hydrogen-containing plasma including H2; forming a liner, such as TiN as a barrier, in the via; forming a second conductive layer adjacent the liner layer and substantially filling the via (col. 6, line 50-col. 7, line 30). The hydrogen-containing plasma would also remove any carbon and oxygen from a residue on the first conductive layer in the via. Unlike claimed invention, Liu doesn't describe a Ti is formed under the liner TiN; however, using a Ti/TiN layers in the process of forming metal interconnect is well known to one skilled in the art as shown here by Liu to form barrier/diffusion layer (col. 4, line 35-48). Lin also describe other metal layer such as W can be used to fill the via hole (col. 4, line 51). Therefore, at the time of the invention, using other metal including W to fill the via hole would have been obvious to one skilled in the art forming a barrier of Ti/TiN and a conductive plug in the via to form an interconnect with an expect of reasonable success.

Unlike claimed invention, Liu doesn't describe a step of Ar sputtering before depositing the liner to remove residue on the conductive layer. Bersin teaches a method of cleaning a via and conductive layer in the via using Ar sputtering (col. 3, line 33-35; col. 4, line 28-31; col. 5, line 5, line 8-10). It would have been obvious for one skilled in the art to modify Liu's in light of

Bersin's cleaning method because the Ar sputtering cleaning step would remove insoluble and nonvolatile residues off the conductive layer in the via.

Unlike claimed invention, Liu doesn't describe an isotropic plasma treatment of the liner layer before formation of the second conductive layer. Wang teaches a method of forming the liner, TiN, where he teaches of a plasma treatment of the TiN with H2 and N2 gases (col. 10, line 10-68). This would read on claimed isotropic plasma treatment of the TiN. It would have been obvious for one skilled in the art to modify Liu's method in light of Wang's plasma treatment because it would decreases resistivity, increases purity, densifies, and improves stability of the TiN as a barrier.

Response to Arguments

6. Applicant's arguments filed 11/12/02 have been fully considered but they are not persuasive.

Referring to applicant's argument that Wang doesn't describe an isotropic process but an anisotropic process because of RF power applied to the showerhead, with the chamber walls and pedestal forming the RF ground. This is found unpersuasive because the anisotropic process usually requires a bias power applied to the bottom electrode or the pedestal; however, there is no bias power applied, this would create an isotropic process.

In response to applicant's argument that there is no suggestion from the references to combine the them for the rejection of claim 10, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in

the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the motivation for combining coming from both in the references themselves or in the knowledge generally available to one of ordinary skill in the art.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DuyVu n Deo whose telephone number is 703-305-0515.

DVD
December 23, 2002

ROBERT KUNEMUND
PRIMARY EXAMINER